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User's Guide

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Model DFG-RS5

Digital Force / Torque Indicator

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Thank you…

Thank you for purchasing an Omega Model DFG-RS5 digital force / torque indicator, designed for use with interchangeable remote force and torque sensors.

With proper usage, we are confident that you will get many years of great service with this product. Omega instruments are ruggedly built for many years of service in laboratory and industrial environments.

This User's Guide provides setup, safety, and operation instructions. Dimensions and specifications are also provided. For additional information or answers to your questions, please do not hesitate to contact us. Our technical support and engineering teams are eager to assist you.

Before use, each person who is to use a Model DFG-RS5 indicator should be fully trained in appropriate operation and safety procedures.

TABLE OF CONTENTS

1 OVERVIEW

1.1 List of included items

Qty.	Part No.	Description
1	12-1049	Carrying Case
1	08-1022	AC adapter body with US, EU, or UK prong
1	08-1026	Battery (inside the indicator)
1	-	Certificate of conformance
1	09-1165	USB cable
1	-	Resource CD (USB driver, user's guide)

1.2 General Overview

The DFG-RS5 is a universal indicator designed for displaying measurements from interchangeable Omega Series RLC and RTQ sensors. These sensors can be handheld or mounted to a fixture or test stand for more sophisticated testing requirements.

These sensors may be used with the DFG-RS5 or DFG-RS3 indicators. They may be disconnected from one indicator and connected to another without the need for re-calibration or re-configuration. All such data is saved within a PCB located inside the smart connector.

The model number, serial number, and capacity of the sensor are identified in the rectangular label located on the sensor connector. The model and serial numbers are also identified in the **Information** screen of the indicator.

1.3 Accuracy and Resolution

Indicator accuracy must be combined with sensor accuracy to determine the total accuracy of the system. Since sensors may be used with either the DFG-RS5 or DFG-RS3 indicators, the accuracy of the indicator being used must be identified and taken into account, as follows:

Indicator Model	Accuracy
DFG-RS5	±0.1% of full scale
DFG-RS3	±0.2% of full scale

The total system accuracy can be calculated by adding the sensor accuracy and indicator accuracy. Refer to the following examples:

Example 1
Model RLC01-100 sensor with Model DFG-RS5 Indicator

RLC01-100 ±0.15% of full scale	+	**DFG-RS5** ±0.1% of full scale	=	**Total** ±0.25% of full scale

This translates into a fixed error of up to:
0.25% x 100 lbF = 0.25 lbF

Example 2
Model RTQ-50Z sensor with Model DFG-RS3 Indicator

RTQ50-50Z ±0.35% of full scale	+	**DFG-RS3** ±0.2% of full scale	=	**Total** ±0.55% of full scale

This translates into a fixed error of up to:
0.55% x 50 ozFin = 0.275 ozFin

Because accuracy is defined as a *percentage of full scale*, the fixed error is possible anywhere on the scale from 0 to the capacity. As such, this value represents an increasingly large error as *percentage of reading* towards the low end of the scale. It is, therefore, recommended that a sensor is selected with capacity as close as possible to the expected load.

The resolution may be different for some sensors depending on which indicator is used. For example, a Series RLC01 force sensor will display finer resolution when connected to a DFG-RS5 indicator than when connected to a DFG-RS3 indicator. Resolution information is shown in the sensors' user's guide.

1.4 Safety / Proper Usage
Read through the following safety instructions thoroughly before using the DFG-RS5 with a sensor:

1. Note the sensor's capacity before use and ensure that the capacity is not exceeded. Producing a load greater than the indicated safe overload value can damage the sensor. An overload can occur whether the sensor's indicator is powered on or off.

2. In order to extend the life of the sensor, avoid repetitive shock and impact loading.

3. When moving the sensor to another location, never lift from the cable or strain relief. This can cause damage to the sensor. Always lift the sensor housing itself.

4. Always ensure that load is applied axially with respect to the sensor.

5. Ensure that the sensor is kept away from water or any other electrically conductive liquids at all times.

6. The sensor and indicator should be serviced by a trained technician only. AC power must be disconnected and the indicator must be powered off before the housing is opened.

7. Always consider the characteristics of the sample being tested before initiating a test. A risk assessment should be carried out beforehand to ensure that all safety measures have been addressed and implemented.

8. Typical materials able to be tested include many manufactured items, such as springs, electronic components, fasteners, caps, films, mechanical assemblies, and many others. Items that should

not be used with the sensor include potentially flammable substances or products, items that can shatter in an unsafe manner, and any other components that can present an exceedingly hazardous situation when acted upon by a force. Always wear eye and face protection when testing, especially in aforementioned hazardous cases. Extra bodily protection should be worn if a destructive failure of a test sample is possible.

9. In aforementioned hazardous situations, it is strongly recommended that a machine guarding system be employed to protect the operator and others in the vicinity from shards or debris.

10. Sensors have threaded holes or chucks, designed for the mounting of grips, fixtures, or attachments. If any such accessories are used, ensure they are mounted firmly to prevent a potential safety risk to the operator and others in the vicinity. If using an accessory from a supplier other than Omega, ensure that it is constructed of suitably rugged materials and components. Similar precautions should be taken when mounting the sensor to a test stand, work bench, or other piece of equipment.

2 POWER

The DFG-RS5 is powered either by an 8.4V NiMH rechargeable battery or by an AC adapter. Since these batteries are subject to self discharge, it may be necessary to recharge the unit after a prolonged period of storage. Plug the accompanying charger into the AC outlet and insert the charger plug into the receptacle on the indicator (refer to the illustration below). The battery will fully charge in approximately 8 hours.

Caution!

Do not use chargers or batteries other than supplied or instrument damage may occur.

If the AC adapter is plugged in, an icon appears in the lower left corner of the display, as follows:

If the AC adapter is not plugged in, battery power drainage is denoted in a five-step process:

1. When battery life is greater than 75%, the following indicator is present:
2. When battery life is between 50% and 75%, the following indicator is present:
3. When battery life is between 25% and 50%, the following indicator is present:
4. When battery life is less than 25%, the following indicator is present:
5. When battery life drops to approximately 2%, the indicator from step 4 will be flashing. Several minutes after (timing depends on usage and whether the backlight is turned on or

off), a message appears, "BATTERY VOLTAGE TOO LOW. POWERING OFF". A 4-tone audio indicator will sound and the indicator will power off.

The indicator can be configured to automatically power off following a period of inactivity. Refer to the **Other Settings** section for details.

If battery replacement is necessary, the battery may be accessed by loosening the two captive screws in the rear half of the housing and separating the two halves of the housing.

3 SETUP

3.1 Connecting a sensor

Insert the connector into the receptacle in the indicator, as shown in Fig. 3.1 below. When fully inserted, the connector will lock into place with a "click".

Fig. 3.1
Appropriate orientation of the connector.

To release the connector, press both buttons on either side of the indicator housing to release the sensor, as shown in Fig. 3.2 below. Pull the connector completely out of the indicator by holding the curved aluminum section. **DO NOT** pull on the cable or strain relief.

Fig. 3.2
Press both buttons on either side of the indicator housing to release the connector.

3.2 Sensor connector orientation

In order to accommodate a variety of testing requirements, the orientation of the connector may be set up in either of the two positions shown below. To change the orientation, loosen the two captive screws on the back side of the housing, separate the two housing halves, rotate one half 180 degrees, and reassemble. Contact between the two halves is made by the spring pins and contact pads on the printed circuit boards.

Sensor connector oriented up

Sensor connector oriented down

3.3 Mounting to a plate

The DFG-RS5 can be mounted to a plate with four thumb screws fastened into the appropriate holes in the rear half of the housing. Refer to the **Dimensions** section for detailed hole information and locations.

3.4 Installing the USB driver

If communicating via USB, install the USB driver provided on the Resource CD.

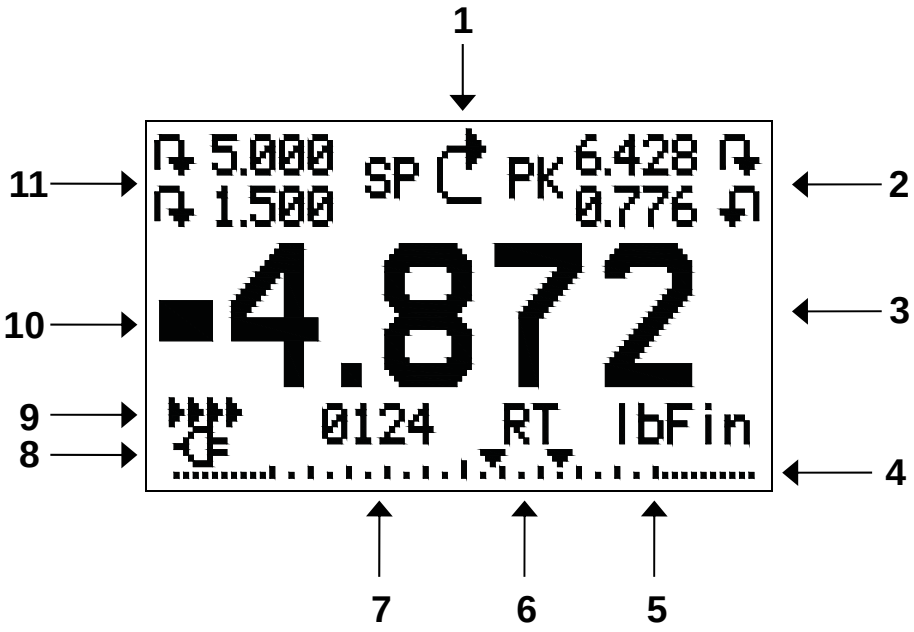
Caution!

Install the USB driver before physically connecting the indicator to a PC with the USB cable.

Further instructions for configuring and using the indicator's outputs are provided in the **Communications and Outputs** section.

4 HOME SCREEN AND CONTROLS

4.1 Home Screen



No.	Name	Description
1	**Measurement direction indicator**	– indicates compression direction (for force sensors) – indicates tension direction (for force sensors) – indicates clockwise direction (for torque sensors) – indicates counter-clockwise direction (for torque sensors) These indicators are used throughout the display and menu.
2	**Peaks**	The maximum measured compression/tension or clockwise/counter-clockwise readings. These readings are reset by pressing **ZERO** or by powering the indicator off and on.
3	**Primary reading**	The current displayed load reading. See **Operating Modes** section for details. If a sensor is not plugged in, this value will be replaced by a message, as follows: SENSOR NOT CONNECTED
4	**Load bar**	Analog indicator to help identify when an overload condition is imminent. The bar increases either to the right or to the left from the midpoint of the graph. Increasing to the right indicates compression or clockwise load, increasing to the left indicates tension or counter-clockwise load. If set points are enabled, triangular markers are displayed for visual convenience. This indicator reflects the actual load, which may not correspond to the primary reading (depends on operating mode). The **ZERO** key does not reset the load bar. See **Operating Modes** section for details.
5	**Units**	The current measurement unit. Abbreviations are as follows: **Force units:** lbF – Pound-force ozF – Ounce-force kgF – Kilogram-force gF – Gram-force N – Newton kN – Kilonewton mN – Millinewton

		Torque units: lbFft – Pound-foot lbFin – Pound-inch ozFin – Ounce-inch kgFm – Kilogram-meter kgFmm – Kilogram-millimeter gFcm – Gram-centimeter Nm – Newton-meter Ncm – Newton-centimeter Nmm – Newton-millimeter **Note:** not all sensor models display all the above units. Refer to the capacity / resolution table for the respective sensor series for details.
6	**Mode**	The current measurement mode. Abbreviations are as follows: RT – Real Time PC – Peak Compression (for force sensors) PT – Peak Tension (for force sensors) PCW – Peak Clockwise (for torque sensors) PCCW – Peak Counter-clockwise (for torque sensors) A – Average Mode ET – External Trigger Mode See **Operating Modes** section for details about each of these modes
7	**Number of stored data points**	The number of stored data points in memory, up to 1,000. Displayed only if **Memory Storage** is enabled for the **DATA** key.
8	**Battery / AC adapter indicator**	Either the AC adapter icon or battery power icon will be shown, depending on power conditions. Refer to the **Power** section for details.
9	**Automatic data output indicator**	If **Auto Output** has been enabled under **Serial / USB Settings**, this indicator is displayed. When automatic data output is occurring, the icon becomes animated. See **Communications** section for details.
10	**High / low limit indicators**	Correspond to the programmed set points. Indicator definitions are as follows: ▲ – the displayed value is greater than the upper load limit ■ – the displayed value is between the load limits ▼ – the displayed value is less than the lower load limit
11	**Set points**	The programmed load limit values. Typically used for pass/fail type testing. One, two, or no indicators may be present, depending on the configuration shown in the **Set Points** menu item.

4.2 Controls

Primary Label	Primary Function	Secondary Label	Secondary Function
⏻	Powers the indicator on and off. Press briefly to power on, press and hold to power off. Active only when the home screen is displayed.	**ENTER**	Various uses, as described in the following sections.
ZERO	Zeroes the primary reading and peaks.	▲ *(UP)*	Navigates up through the menu and sub-menus.
MENU	Enters the main menu.	**ESCAPE**	Reverts one step backwards through the menu hierarchy.
MODE	Toggles between measurement modes.	▼ *(DOWN)*	Navigates down through the menu and sub-menus.
DATA	Stores a value to memory, transmits the current reading to an external device, and/or initiates automatic data output, depending on setup.	**DELETE**	Enables and disables **Delete** mode while viewing stored data.
UNITS	Toggles between measurement units.	**DIRECTION**	Toggles between tension and compression (or clockwise and counter-clockwise) directions while configuring set points and other menu functions.
CLEAR	Zeroes the peak readings, but retains the primary reading.	**N/A**	N/A

4.3 Menu navigation basics

Most of the indicator's various functions and parameters are configured through the main menu. To access the menu press **MENU**. Use the **UP** and **DOWN** keys to scroll through the items. The current selection is denoted with clear text over a dark background. Press **ENTER** to select a menu item, then use **UP** and **DOWN** again to scroll through the sub-menus. Press **ENTER** again to select the sub-menu item.

For parameters that may be either selected or deselected, press **ENTER** to toggle between selecting and deselecting. An asterisk (*****) to the left of the parameter label is used to indicate when the parameter has been selected.

For parameters requiring the input of a numerical value, use the **UP** and **DOWN** keys to increment or decrement the value. Press and hold either key to auto-increment at a gradually increasing rate. When the desired value has been reached, press **ENTER** to save the change and revert back to the sub-menu item, or press **ESCAPE** to revert back to the sub-menu item without saving. Press **ESCAPE** to revert one step back in the menu hierarchy until back into normal operating mode.

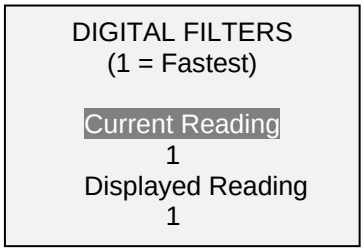
Refer to the following sections for details about setting up particular functions and parameters.

Note: As described above, the smart connector retains all configuration and calibration data for the sensor, which includes menu settings. As such, a sensor must be connected in order for menu changes to be saved with that particular sensor. If a sensor is not connected and the **MENU** key is pressed, it is possible to browse through the menu parameters and make changes, but changes will not be saved.

5 DIGITAL FILTERS

Digital filters are provided to help smooth out the readings in situations where there is mechanical interference in the work area or test sample. These filters utilize the moving average technique in which consecutive readings are pushed through a buffer and the displayed reading is the average of the buffer contents. By varying the length of the buffer, a variable smoothing effect can be achieved. The selection of 1 will disable the filter since the average of a single value is the value itself.

To access digital filter settings, select **Filters** from the menu. The display appears as follows:



Two filters are available:

Current Reading – Applies to the peak capture rate of the instrument.

Displayed Reading – Applies to the primary reading on the display.

Available settings: *1,2,4,8,16,32,64,128,256,512,1024.* It is recommended to keep the current reading filter at its lowest value for best performance, and the displayed reading filter at its highest value for best stability.

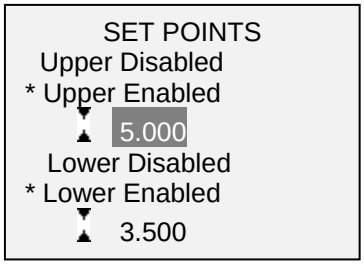
6 SET POINTS

6.1 General Information

Set points are useful for tolerance checking (pass/fail), triggering an external device such as a motorized test stand, or alarm indication in process control applications. Two limits, high and low, are specified and stored in the non-volatile memory of the instrument and the primary reading is compared to these limits. The results of the comparisons are indicated through the three outputs provided on the 15-pin connector, thus providing "under", "in range", and "over" signaling. These outputs can be connected to indicators, buzzers, or relays as required for the application.

6.2 Configuration

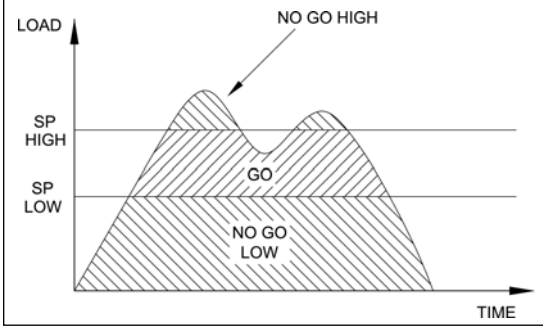
To configure set points, select **Set Points** from the menu. The screen appears as follows:



Either one, two, or none of the set points may be enabled. To toggle between the tension and compression (or clockwise and counter-clockwise) directions, press the **DIRECTION** key.

If two set points have been enabled, they are displayed in the upper left corner of the display. If only one set point has been enabled, the word "OFF" appears in place of the value. If no set points have been enabled, the upper left corner of the display will be blank.

When set points are enabled, the following indicators are shown to the left of the primary reading:



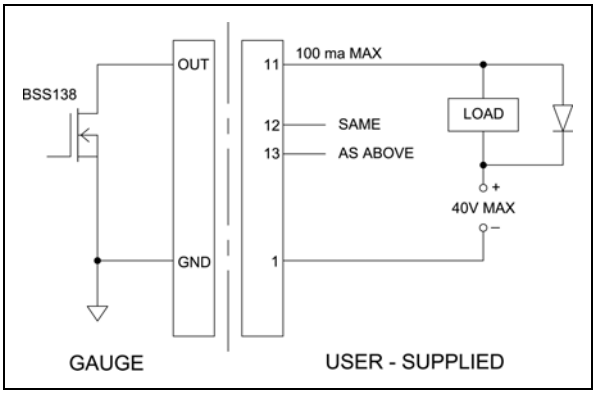
▲ – the displayed value is greater than the upper load limit (NO GO HIGH)

■ – the displayed value is between the limits (GO)

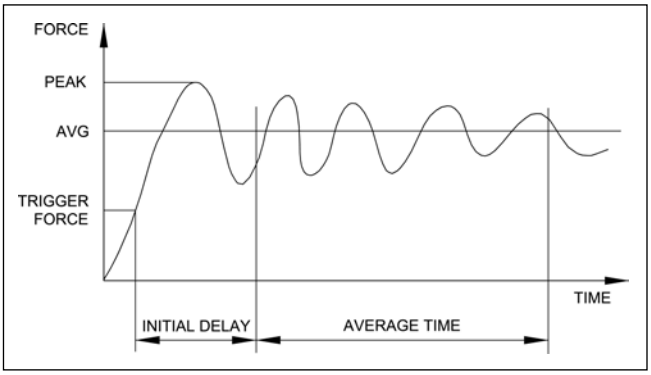
▼ – the displayed value is less than the lower load limit (NO GO LOW)

Note: Set point indicators and outputs reference the displayed reading, not necessarily the current live load.

6.3 Set Point Outputs Schematic Diagram



6.4 Using Set Points to Control an Omega MTS300 Test Stand



When using set points to stop/cycle an MTS300 test stand, the upper and lower set points must be set to **opposite** measuring directions. **Both** set points must be set, even if the intended application is to stop/cycle at only one of the set points. The opposite set point should be a value sufficiently large that it does not get triggered during the course of the test.

7 OPERATING MODES

Caution!

In any operating mode, if the capacity of the instrument has been exceeded by more than 110%, the display will show "OVER" to indicate an overload. A continuous audible tone will be sounded until the MENU key has been pressed or the load has been reduced to a safe level.

Five operating modes are possible with the DFG-RS5 indicator. To cycle between the modes, press **MODE** while in the home screen.

7.1 Real time (RT)

The primary reading corresponds to the live measured reading.

7.2 Peak Compression (PC) / Peak Clockwise (PCW) - *for force / torque sensors, respectively*

The primary reading corresponds to the peak compression or clockwise reading observed. If the actual load decreases from the peak value, the peak will still be retained in the primary reading area of the display. Pressing **ZERO** will reset the value.

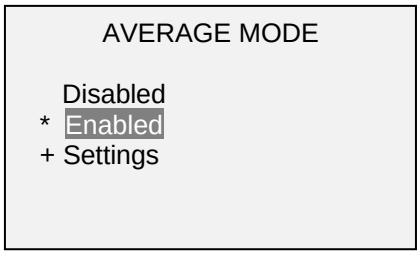
7.3 Peak Tension (PT) / Peak Counter-clockwise (PCCW) – *for force / torque sensors, respectively*

Same as above, but for tension / counter-clockwise readings.

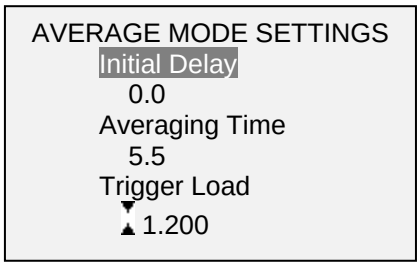
7.4 Average Mode (AVG)

Average mode is used to obtain an average load reading over a specified period of time. Applications include measurement of peel force, bearing torque, muscle strength, frictional force, and other tests requiring time-averaged readings.

Before the parameters of Average Mode can be configured, it must be enabled. To do so, select **Average Mode** from the menu, scroll to **Enable** and press **ENTER**. The display appears as follows:



Then, scroll to **Settings**, and press **ENTER** to configure the parameters. The parameters are as follows:



Parameter	Description
Initial Delay	The time delay, in seconds, before the averaging sequence commences.
Averaging Time	The time duration, in seconds, of the averaging sequence.
Trigger Load	The minimum load required to start the averaging sequence. Toggle between compression and tension (or clockwise and counter-clockwise) directions by pressing the **DIRECTION** key. Initial delay follows the trigger load.

After the parameters have been configured and the menu has been exited, press **MODE** until **AVG** is displayed. Then press **ZERO**. Average mode is now armed, and the averaging sequence will commence when the trigger load has occurred. The current status of the average sequence is displayed below the primary reading, as follows:

Step	Status Abbreviation	Description
1	TRIG WAIT	The trigger load has not yet occurred.
2	INIT DLY	The initial delay is currently taking place.
3	AVERAGING	The indicator is collecting readings. The status will be flashing until averaging has been completed.
4	AVRG DONE	Averaging has been completed. The average load is displayed in the primary reading.

At the completion of the averaging sequence, the peak values are retained until **ZERO** is pressed. Another averaging sequence may be started after **ZERO** has been pressed. To exit Average mode, press **MODE** and select the desired measuring mode.

7.5 External Trigger (ET)

This mode of operation is useful for measuring electrical contact activation load as well as synchronization of multiple instruments for a "snapshot" view of applied loads. It is possible to capture the reading with a normally open contact (high to low transition of the trigger signal) or a normally closed contact (low to high transition).

Before the parameters of External Trigger Mode can be configured, it must be enabled. To do so, enter the main menu, select **External Trigger**, scroll to one of the four available options and press **ENTER**. The options are as follows:

EXTERNAL TRIGGER

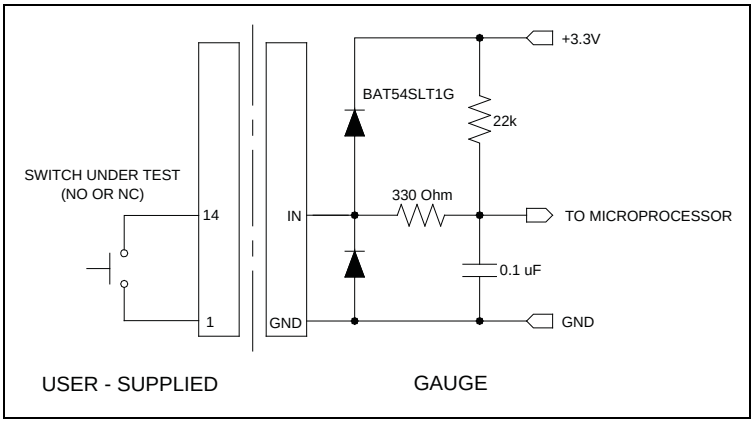
* Disabled
Momentary Hi->Lo
Momentary Lo->Hi
Maintained High
Maintained Low

Option	Description
Momentary High → Low	The display will freeze the captured reading until **ZERO** is pressed. Applies to a high to low transition of the trigger signal.
Momentary Low → High	The display will freeze the captured reading until **ZERO** is pressed. Applies to a low to high transition of the trigger signal.
Maintained High	The display will show the captured reading only for as long as a high signal is maintained.
Maintained Low	The display will show the captured reading only for as long as a low signal is maintained.

After the selection has been made and the menu has been exited, press **MODE** until **ET** is displayed. External Trigger mode is now armed. Refer to the pin diagram in the **Communications** section for connection information. To exit External Trigger mode, press **MODE** and select the desired measuring mode.

Note: As long as external trigger has been enabled, it is still active even if the indicator is in **Real Time** mode. After the display freezes, any programmed set points will be active. However, if the indicator is in **External Trigger** mode, any programmed set points will be inactive.

7.6 External Trigger Schematic



8 DATA MEMORY AND STATISTICS

The DFG-RS5 has a storage capacity of 1,000 data points. Readings may be stored, viewed, and output to an external device. Individual, or all, data points may be deleted. Statistics are calculated for the data presently in memory.

To enable memory storage, select **DATA Key** from the menu, then scroll to **Memory Storage** and press **ENTER**. Then exit the menu. In the home screen, the data record number **0000** appears below the primary reading. Press **DATA** at any time to save the displayed reading. The record number will increment each time **DATA** is pressed. If **DATA** is pressed when memory is full the message "MEMORY FULL" will be flashed at the bottom of the display and a double audio tone will be sounded.

To view, edit, and output stored readings and statistics, select **Memory** from the menu. The screen appears as follows:

```
MEMORY
View Data
View Statistics
Output Data
Output Statistics
Output Data & Stats
Clear All Data
```

8.1 View Data

All the saved data points may be viewed. The record number is displayed, along with the corresponding value and presently set unit of measurement. Any readings may be deleted individually. To do so, scroll to the desired reading and press **DELETE**. The letter "D" appears to the left of the record number, indicating that the indicator is in **Delete** mode, as follows:

```
0001        8.450 Nm
0002        9.220 Nm
0003        8.445 Nm
0004        8.895 Nm
D 0005      9.095 Nm
0006        8.990 Nm
0007        9.045 Nm
```

Press **ENTER** to delete the value. To exit **Delete** mode, press **DELETE** again. Any number of readings may be individually deleted, however, all readings may also be cleared simultaneously. Refer to the **Clear All Data** section for details.

8.2 Statistics
Statistical calculations are performed for the saved values. Calculations include number of readings, minimum, maximum, mean, and standard deviation.

8.3 Output Data
Press **ENTER** to output data to an external device. The display will show, "SENDING DATA…", then "DATA SENT". If there was a problem with communication, the display will show, "DATA NOT SENT". Saved data can be downloaded by some Omega data collection programs. Refer to their respective user's guides for details.

8.4 Output Statistics
Press **ENTER** to output statistics to an external device. The display will show, "SENDING STATS…", then "STATS SENT". If there was a problem with communication, the display will show, "STATS NOT SENT".

8.5 Output Data & Stats
Press **ENTER** to output data and statistics to an external device. The display will show, "SENDING DATA", then "SENDING STATS…", then "DATA SENT", then "STATS SENT". If there was a problem with communication, the display will show, "DATA NOT SENT" and/or "STATS NOT SENT".

8.6 Clear All Data
Press **ENTER** to clear all data from the memory. A prompt will be shown, "CLEAR ALL DATA?". Select **Yes** to clear all the data, or **No** to return to the sub-menu.

> *Shortcut for clearing all data:* In the main menu, highlight **Memory** and press **DELETE**. The same prompt will be shown as above.

For output of data and/or statistics, RS-232 or USB output must be enabled. Data formatting is <CR><LF> following each value. Units can be either included or excluded. Output of data via the Mitutoyo output is possible, however, output of statistics is not. Refer to the **Communications** section for details.

Note: Data is not retained while the gauge is powered off. However, the gauge protects against accidental or automatic power-off. If manually powering the instrument off, or if the inactivity time limit for the **Automatic Shutoff** function has been reached, the following warning message appears:

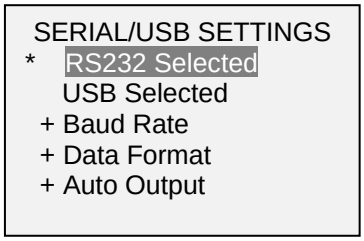
If no option is selected, this screen will be displayed indefinitely, or until battery power has been depleted.

9 COMMUNICATIONS AND OUTPUTS

Communication with the DFG-RS5 indicator is achieved through the micro USB or 15-pin serial ports located at the bottom of the instrument, as shown in the illustration in the **Power** section. Communication is possible only when the indicator is in the main operating screen (i.e. not in a menu or configuration area).

9.1 Serial / USB

To set up RS-232 and USB communication, select **Serial/USB Settings** from the menu. The screen appears as follows:



Select either RS-232 or USB input (output is always simultaneous through both the USB and RS-232 ports). RS-232 must be selected when communicating through an Omega test stand controller. When communicating from the indicator directly to a PC or data collector, either RS-232 or USB can be selected as required. Press **DATA** to transmit individual data points or to commence an automatic output sequence (see **Automatic Output** sub-section for details). Single point or continuous data may also be requested via ASCII commands from an external device (see **Command Set** sub-section for details).

Communication settings are permanently set to the following:

Data Bits: **8**
Stop Bits: **1**
Parity: **None**

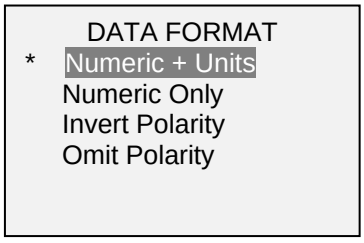
Other settings are configured as follows:

9.1.1 Baud Rate

Select the baud rate as required for the application. It must be set to the same value as the receiving device. When communicating with an Omega test stand controller, the baud rate must be set to 9,600.

9.1.2 Data Format

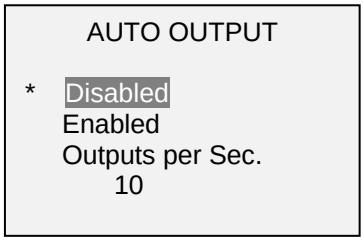
Select the desired data format. The screen appears as follows:



Selection	Description
Numeric + Units	Output format includes the value and unit of measure. Compression/clockwise values have positive polarity, tension/counter-clockwise values have negative polarity.

Numeric Only	Output format includes the value only. Polarity same as above.
Invert Polarity	Compression/clockwise values have negative polarity, tension/counter-clockwise values have positive polarity. May be selected in addition to the Numeric + Units / Numeric Only selection.
Omit Polarity	Both directions are formatted with positive polarity. May be selected in addition to the Numeric + Units / Numeric Only selection.

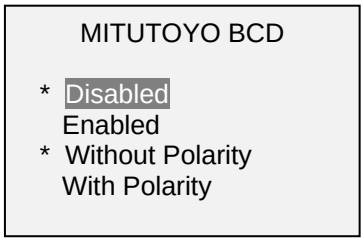
9.1.3 Automatic Output
The indicator has the ability to output data continuously via RS-232 or USB. To enable automatic output, select **Auto Output** from the **Serial/USB Settings** sub-menu. The screen appears as follows:



Select **Enabled** to activate automatic output. The number of outputs per second can be set to 1, 2, 5, 10, 25, 50, 125, or 250. The capabilities of the receiving device should be considered when selecting the data output rate.

After the settings have been saved, revert to the home screen. An icon appears in the lower left corner of the display, as follows: ▶▶▶ This indicates that automatic data output has been armed. Automatic output of data may be initiated by pressing **DATA** or by sending the appropriate ASCII command from an external device (see **Command Set** sub-section for details). The icon will become animated, signaling that automatic output is occurring. Press **DATA** again to end the data transmission.

9.2 Mitutoyo BCD settings
This output is useful for connection to data collectors, printers, multiplexers, or any other device capable of accepting Mitutoyo BCD data. Individual data points may be transmitted by pressing **DATA** or by requesting it from the Mitutoyo communication device (if available). To enable Mitutoyo output, select the desired format – either with polarity or without polarity. The screen appears as follows:



9.3 Analog Output
This output can be used for chart recorders, oscilloscopes, data acquisition systems, or any other compatible devices with analog inputs. The output produces ±1 volt at full scale of the sensor. The polarity of the signal is positive for compression/clockwise and negative for tension/counter-clockwise.

9.4 DATA Key Functions
The **DATA** key can be configured to perform several functions. To configure the **DATA** key, select **DATA Key** from the menu. The display appears as follows:

DATA KEY

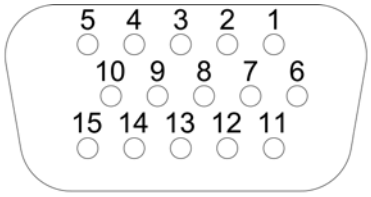
* RS232/USB Output
Mitutoyo Output
Memory Storage

Three options are available:

Selection	Function when pressing DATA
RS232/USB Output	Outputs data via the serial and USB ports
Mitutoyo Output	Outputs data via Mitutoyo (Digimatic) through the serial port
Memory Storage	Stores a reading to memory (refer to the **Memory** section for details)

Any combination of the above functions may be selected.

9.5 I/O Connector Pin Diagram (female)



DB-9HD-15

Pin No.	Description	Input / Output
1	Signal Ground	---
2 *	Tension / Counter-clockwise Overload *	Output
3	RS-232 Receive	Input
4	RS-232 Transmit	Output
5	+12V DC	Output
6	Analog Output	Output
7 *	Compression / Clockwise Overload *	Output
8	Mitutoyo Clock Output Bit 2	Output
9	Mitutoyo Data Output Bit 0	Output
10	Mitutoyo Request Input Bit 3	Input
11 **	Set Point Pin 1 **	Output
12 **	Set Point Pin 2 **	Output
13 **	Set Point Pin 3 **	Output
14	External Trigger	Input
15	Mitutoyo Ready Output Bit 1	Output

* Maximum voltage: 40V.

** The output assignments depend on several factors described in the table below. Output functions always reference the primary reading on the display, regardless of the current mode.

Load	Pin 11	Pin 12	Pin 13
Upper and Lower Set Points are C / CW			
Greater than or equal to upper set point	On	Off	Off
Between upper and lower set points	Off	Off	On
Less than or equal to lower set point	Off	On	Off
Upper and Lower Set Points are T / CCW			
Greater than or equal to upper set point	Off	On	Off
Between upper and lower set points	Off	Off	On
Less than or equal to lower set point	On	Off	Off
Upper Set Point is C / CW, Lower Set Point is T / CCW			
Greater than or equal to upper set point, in C / CW	Off	On	Off
Between upper and lower set points	Off	Off	On
Greater than or equal to lower set point, in T / CCW	On	Off	Off
Upper Set Point is T / CCW, Lower Set Point is C / CW			
Greater than or equal to upper set point, in T / CCW	Off	On	Off
Between upper and lower set points	Off	Off	On
Greater than or equal to lower set point, in C / CW	On	Off	Off

C = compression, T = tension, CW = clockwise, CCW = counter-clockwise

9.6 Command Set / Gauge Control Language 2 (GCL2)

The DFG-RS5 may be controlled by an external device through the RS-232 or USB channel. The following is a list of supported commands and their explanations. All commands must be terminated with a Carriage Return character or with a Carriage Return/Line Feed combination. The indicator responses are always terminated with a Carriage Return/Line Feed.

Request Readings

?	Request the displayed reading (dependant on operating mode)
?C	Request the current (real time) reading
?PT	Request the peak tension reading
?PC	Request the peak compression reading
?CW	Request the peak clockwise reading
?CCW	Request the peak counter-clockwise reading
?ET	Request the reading obtained during the External trigger mode
?A	Request the average reading obtained during the Average mode

Units (available units depend on the sensor used)

LB	Switch unit to pound-force
OZ	Switch unit to ounce-force
KG	Switch unit to kilogram-force
G	Switch unit to gram-force
N	Switch unit to Newton
MN	Switch unit to milli-Newton
KN	Switch unit to kilo-Newton
LBFT	Switch unit to pound-foot
LBIN	Switch unit to pound-inch
OZIN	Switch unit to ounce-inch
KGM	Switch unit to kilogram-meter
KGMM	Switch unit to kilogram-millimeter
GCM	Switch unit to gram-centimeter
NM	Switch unit to Newton-meter
NCM	Switch unit to Newton-centimeter

NMM	Switch unit to Newton-millimeter

Basic Functions (available measurement directions depend on the sensor used)

CUR	Current mode (real time mode) for primary reading
PT	Peak Tension mode for primary reading
PC	Peak Compression mode for primary reading
PCW	Peak Clockwise mode for primary reading
PCCW	Peak Counter-clockwise mode for primary reading
CLR	Clear peaks
Z	Zero display and perform the CLR function

Filters

FLTCn	Digital filter for displayed readings
FLTPn	Digital filter for current readings n= 0-10, filter = 2^n, ex: n=0= no filter, n=10=1024 samples averaged

Memory & Statistics

MEM	Transmit all stored readings
STA	Transmit statistics

Set Points

SPHD	Disable high set point
SPLD	Disable low set point
SPHn	High set point. n=value (+ for C/CW, - for T/CCW)
SPLn	Low set point. n=value (+ for C/CW, - for T/CCW) **Note:** High set point value must be greater than low set point value if both values are set to the same polarity.

USB/RS-232 Communication

FULL	USB/RS-232 transmission with units
NUM	USB/RS-232 transmission without units (only numeric values)
AOUTn	Auto-transmit n times per second n=1,2,5,10,25,50,125,250. 0=disabled **Note:** n = 1 = yields 50 times per second.
IPOLn	Invert polarity of output. n=1=invert polarity. n=0=normal (default) **Note:** Normal polarity is positive for compression and negative for tension.
OPOLn	Omit polarity of output. n=1=omit polarity. n=0=include polarity (default) **Note:** The "+" sign is always omitted. A "–" sign is sent when polarity is enabled.

Mitutoyo Communication

MIT	Enable Mitutoyo output
MITD	Disable Mitutoyo output
POL	Mitutoyo output with polarity (+ for compression, - for tension)
NPOL	Mitutoyo output without polarity (absolute value)
PM	Print/send data to a Mitutoyo-compatible device

Averaging

A	Enable Average mode
AD	Disable Average mode
AM	Select Average mode (if enabled) for primary reading
ATn	Average time. n=0.1-300.0 seconds
DELn	Initial delay. n=0.1-300.0 seconds
TRFn	Trigger force. n=value (+ for compression/clockwise, - for tension/counter-clockwise)

External Trigger

ETH	Enable high level-triggered External trigger mode
ETL	Enable low level-triggered External trigger mode
ETHL	Enable reading captured on a high to low transition
ETLH	Enable reading captured on a low to high transition
ETD	Disable External trigger mode

Input / Output Bits

Sn	Set output bit (open drain, pull to ground). n=0,1,2
Cn	Clear output bit. n=0,1,2
Rn	Read current status of output bit or level of input pin. n=0,1,2,3

Personality

RN	Read product name
RM	Read model number
RV	Read firmware version number
RS	Read serial number

Other Commands

AOFFn	Auto-shutoff. n=0-30 minutes. 0=auto shutoff disabled
SAVE	Save current settings in nonvolatile memory
LIST	List current settings and status

Following is an example LIST output:
V1.00;LBF;CUR;FLTC8;FLTP1;AOUT00;AOFF5;FULL;IPOL0;OPOL0;MIT;POL;B0
All fields are separated by ";". The first field shows the firmware version, the last field shows the remaining battery power (B0=full charge, B3=minimum power). All other fields show the status of settings and features using the same abbreviations as the commands to set them.

Any detected errors are reported back by means of the following error codes:

*10	Illegal command
*11	Not applicable
*21	Invalid specifier
*22	Value too large

10 CALIBRATION

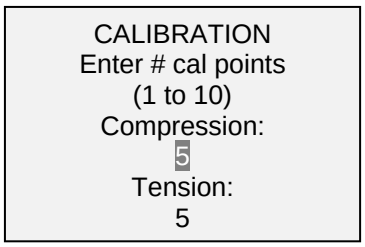
10.1 Initial Physical Setup

The sensor should be mounted vertically to a test stand or fixture rugged enough to withstand a load equal to the full capacity of the sensor. Certified deadweights, torque arms/wheels, and/or master load cells should be used, along with appropriate mounting brackets and fixtures. Caution should be taken while handling such equipment.

10.2 Calibration Procedure

In the interests of simplicity and brevity, the following instructions use force terminology only. Such wording is displayed only when a force sensor is being calibrated. When a torque sensor is being calibrated, the terms **COMPRESSION** and **TENSION** are replaced by **CLOCKWISE** and **COUNTER-CLOCKWISE**, respectively.

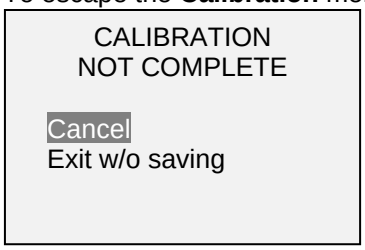
1. Select **Calibration** from the menu. The display appears as follows:



The sensor can be calibrated at up to 10 points in each direction. Enter the number of calibration points for each direction (compression and tension or clockwise and counter-clockwise). At least one point must be selected for each direction. For single-direction sensors such as Omega's Series RLC02, only one direction is allowed.

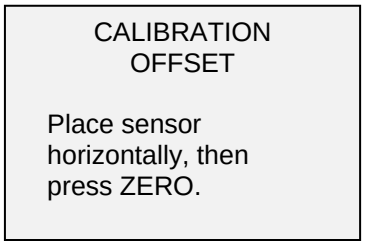
Note: To achieve the accuracy specification of ±0.1% + sensor, it is recommended to calibrate the sensor at 5 or more even increments in both the tension and compression directions. For example, a sensor with capacity of 10 lbF should be calibrated at 2, 4, 6, 8, and 10 lbF loads in each direction.

2. To escape the **Calibration** menu at any time, press **ESCAPE**. The display appears as follows:

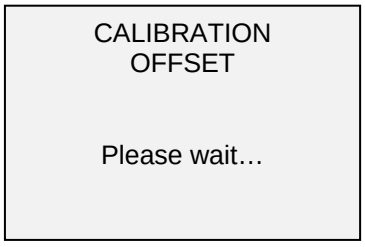


Selecting "Cancel" will revert back to the Calibration setup. Selecting "Exit w/o saving" will return to the menu without saving changes.

3. After the number of calibration points has been entered, press **ENTER**. The display appears as follows:



4. Place the force sensor horizontally on a level surface free from vibration, then press **ZERO**. The indicator will calculate internal offsets, and the display appears as follows:



CALIBRATION OFFSET Sensor passed Analog passed	If failed:	CALIBRATION OFFSET Sensor failed Analog failed

5. The following screen appears after the offsets have been calculated:

CALIBRATION COMPRESSION Attach necessary weight fixtures, then press ENTER.

Attach weight fixtures (brackets, hooks, etc), as required. Do not yet attach any weights or apply any calibration loads. Press **ENTER**.

6. The display appears as follows:

CALIBRATION COMPRESSION Optionally exercise sensor, then press ENTER.

Optionally exercise the sensor several times (at full scale, if possible), then press **ENTER**.

7. The display appears as follows:

CALIBRATION COMPRESSION Gain adjust Apply full scale load 10.000 lbF +/-20%, then press ENTER.

Apply a weight equal to the full scale of the instrument, then press **ENTER**.

8. After displaying "Please wait…" the display appears as follows:

CALIBRATION COMPRESSION Ensure no load, then press ZERO.

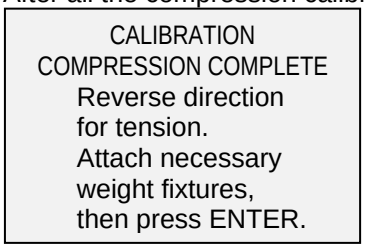
Remove the load applied in Step 8, leave the fixtures in place, then press **ZERO**.

9. The display appears as follows:

Use the **UP** and **DOWN** keys to adjust the load value as required. The load values default to even increments, as indicated by the previously entered number of data points (even increments are recommended for best results). For example, if a 50 lbF capacity sensor is calibrated, and 5 data points were selected, the load values will default to 10, 20, 30, 40, and 50 lb. Apply the calibration load. Then press **ENTER**.

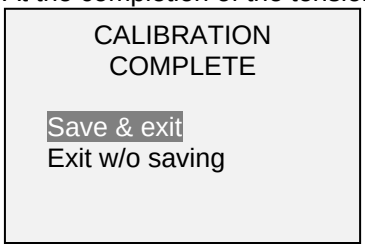
Repeat the above step for the number of data points selected.

10. After all the compression calibration points have been completed, the display appears as follows:



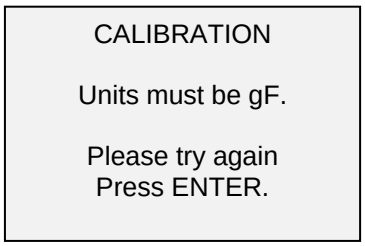
Press **ENTER**.

11. At the completion of the tension calibration, the display appears as follows:



To save the calibration information, select "Save & exit". To exit without saving the data select "Exit without saving".

12. Any errors are reported by the following screens:



Displayed at the start of calibration if a disallowed unit is selected.

CALIBRATION

Load not stable.

Please try again.

Ensure that the load is not swinging, oscillating, or vibrating in any manner. Then try again.

CALIBRATION
COMPRESSION

Load too low.

Please try again.

Causes:

1. The calibration weight does not match the set value.

2. If using a DFG-RSA configurable adapter, ensure that the output signal leads (SG+ and SG-) have been installed into the appropriate terminal blocks. Some sensor manufacturers consider SG+ to be a compression value, while others consider it to be a tension value. If the indicator is expecting a compression load but it is receiving a tension signal, calibration cannot continue. Verify that the tension/compression indicator on the home screen properly corresponds to the load direction, and switch the signal leads, if required.

CALIBRATION
TENSION

Load too close
to previous.
Please try again.

The entered calibration point is too close to the previous point.

11 PASSWORDS

Two separate passwords may be set to control access to the Calibration section and to the menu and other keys. To access the passwords setup screen, select **Passwords** from the menu. The display appears as follows:

PASSWORDS
Calibration
Menu Key
Sensor Lock
Units Key
Mode Key
+ More

Select "+ More" for additional options:

PASSWORDS 2

Zero Key
Data Key
Clear Key
Power Key

11.1 Calibration Password
Select **Calibration** from the sub-menu. The display appears as follows:

CALIBRATION PASSWORD

* Disabled
Enabled
Set Password
(0000 – 9999)
5000

To set the password, select **Enabled**, then **Set Password**. Use the **UP** and **DOWN** keys to increment and decrement the value, from 0 to 9999. When the desired value has been selected, press **ENTER**, then **ESC** to exit the sub-menu.

11.2 Menu Key Password
If enabled, every time the **MENU** key is selected, a password must be provided. Select **Menu Key** from the sub-menu. Follow the same procedure as described above.

11.3 Sensor Lock
The indicator may be configured to operate only when a particular sensor is connected. To enable, ensure that the appropriate sensor is connected. Then, highlight **Sensor Lock** in the sub-menu, and press **ENTER**.

After configuration, if a different sensor is connected, the display appears as follows:

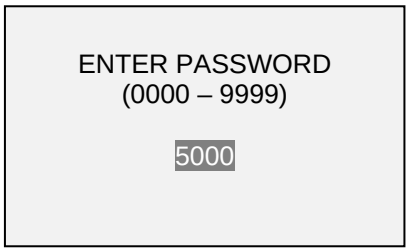
WRONG SENSOR
CONNECTED

Connect sensor
SN 1234567
then press ENTER.

Connect the correct sensor, then press **ENTER** to continue. If the correct sensor is not available, contact Omega for further instructions.

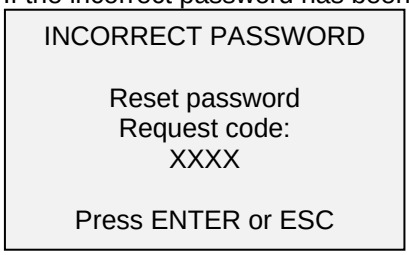
11.4 Locking Out Other Keys
Other keys may be locked out individually. Select any combination of keys (**UNITS**, **MODE**, **ZERO**, **DATA**, **CLEAR**, **POWER**) by pressing **ENTER** in the **Passwords** sub-menu. Pressing a locked key will prompt the message "KEY PROTECTED" instead of performing the key's function.

11.5 Password Prompts
If passwords have been enabled, the following will be displayed when pressing the **MENU** key or accessing the **Calibration** section:



Use the **UP** and **DOWN** keys to select the correct password, then press **ENTER** to continue.

If the incorrect password has been entered, the display appears as follows:



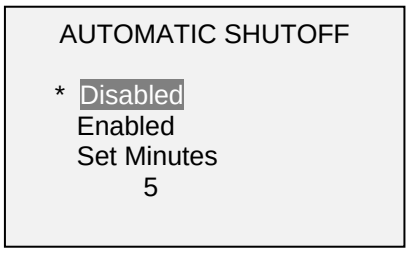
To re-enter the password, press ESC to exit to the home screen. Then, access the desired function and enter the password again when prompted.

If the password has been misplaced, it can be reset. Press **ENTER** to generate a *request code*. The *request code* must be supplied to Omega, who will then provide a corresponding *authorization code*. Enter the *activation code* to disable the password.

12 OTHER SETTINGS

12.1 Automatic Shutoff

The indicator may be configured to automatically power off following a period of inactivity while on battery power. Inactivity is defined as the absence of any key presses or load changes of 100 counts or less. To access these settings, select **Automatic Shutoff** from the menu. The display appears as follows:

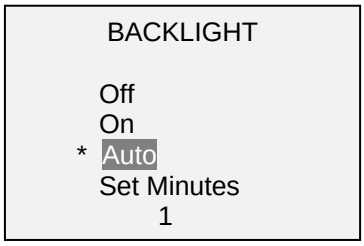


Select **Disabled** to disable automatic shutoff. Select **Enabled** to enable it. The length of time of inactivity is programmed in minutes via the **Set Minutes** parameter. Available settings: 5-30, in 5 minute increments.

Note: If the AC adapter is plugged in, the indicator will ignore these settings and remain powered on until the **POWER** key is pressed.

12.2 Backlight

Although the backlight may be turned on and off at any time by pressing the **BACKLIGHT** key, there are several available initial settings (applicable upon powering on the indicator). To access these settings, select **Backlight** from the menu. The display appears as follows:

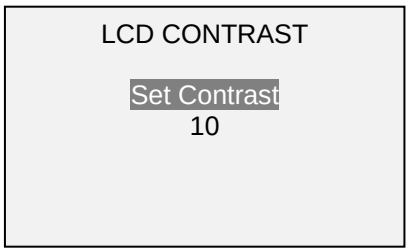


Selection	Description
Off	Backlight to be off upon powering on the indicator.
On	Backlight to be on upon powering on the indicator.
Auto	Backlight to be on upon powering indicator, but will shut off after a period of inactivity (as defined in the **Automatic Shutoff** sub-section). The backlight will turn on again when activity resumes. The length of time of inactivity is programmed in minutes via the **Set Minutes** parameter. Available settings: *1-10*, in 1 minute increments.

Note: If the AC adapter is plugged in, the indicator will ignore these settings and keep the backlight on.

12.3 LCD Contrast

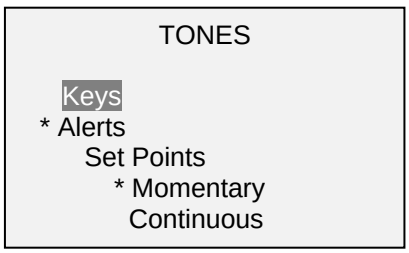
The contrast of the display may be adjusted. Select **LCD Contrast** from the menu. The screen appears as follows:



Press **ENTER** to modify the contrast. Select a value from 0 to 25, 25 producing the most contrast.

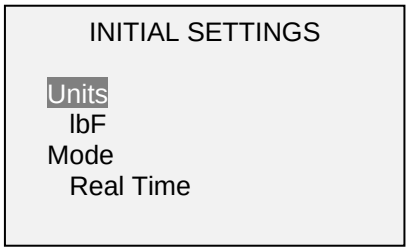
12.4 Tones

Audible tones can be enabled for all key presses and alerts, such as overload, set point value reached, etc. The Set Point alert can be configured to be either a momentary tone or a continuous tone (until the load is restored to a value between the set points). To configure the functions for which audible tones will apply, select **Tones** from the menu. The screen appears as follows:



12.5 Initial settings

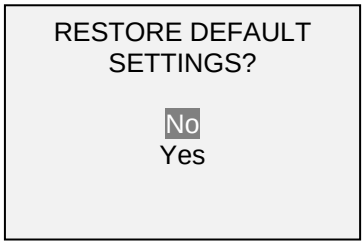
This section is used to configure the initial settings upon powering on the indicator. The initial units of measurement and the primary reading measurement mode may be configured. To access these settings, select **Initial Settings** from the menu. The screen appears as follows:



The default unit of measure depends on the sensor series. The default mode is Real Time, regardless of sensor.

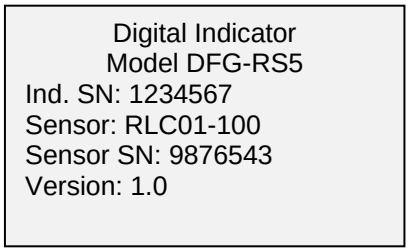
12.6 Restore Default Settings

Default factory settings can be restored by selecting **Restore Defaults** from the menu. The settings may be found in the **Specifications** section. The screen appears as follows:



12.7 Information / Welcome Screen

The following screen is displayed at power up and can be accessed at any time by selecting **Information** from the menu:



13 SPECIFICATIONS

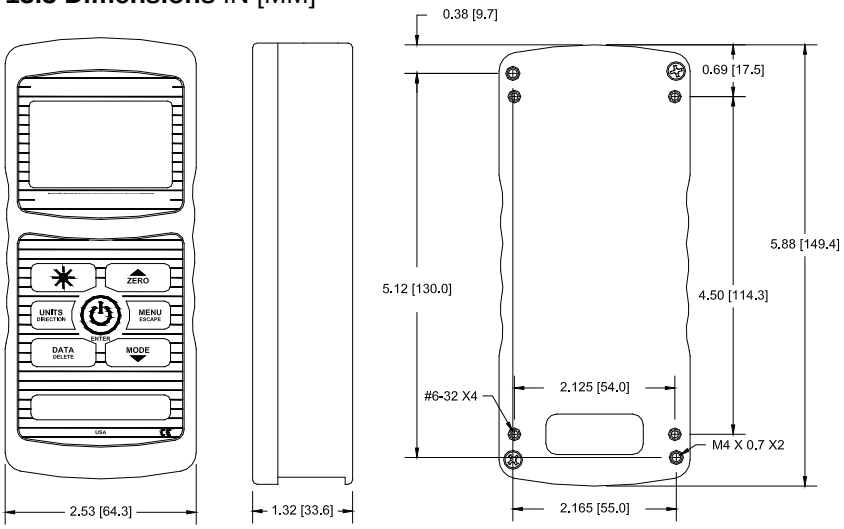
13.1 General

Accuracy:	±0.1% of full scale + sensor
Sampling rate:	7,000 Hz
Power:	AC or rechargeable battery. Low battery indicator appears when battery level is low, and indicator powers off automatically when power reaches critical stage.
Battery life:	**Backlight on:** up to 7 hours of continuous use **Backlight off:** up to 24 hours of continuous use
Measurement units:	lbF, ozF, gF, kgF, N, kN, mN, lbFft, lbFin, ozFin, kgFm, kgFmm, gFcm, Nm, Ncm, Nmm (depending on sensor)
Outputs:	**USB / RS-232:** Fully configurable up to 115,200 baud. Includes Gauge Control Language 2 for full computer control. **Mitutoyo (Digimatic):** Serial BCD suitable for all Mitutoyo SPC-compatible devices. **Analog:** ±1 VCD, ±2% of full scale at capacity. **General purpose:** Three open drain outputs, one input. **Set points:** Three open drain lines.
Weight:	0.7 lb [0.3 kg]
Included accessories:	Carrying case, AC adapter, battery, USB cable, resource CD (USB driver and user's guide), NIST-traceable certificate of calibration
Environmental conditions:	40 - 100°F, max. 96% humidity, non-condensating
Warranty:	3 years (see individual statement for further details)

13.2 Factory Settings

Parameter	Setting
Set points	
Upper	Disabled (defaults to 80% of full scale, C/CW, when enabled)
Lower	Disabled (defaults to 40% of full scale, C/CW, when enabled)
Filters	
Current	8
Displayed	512
Average mode	Disabled
Initial Delay	0
Trigger Force / Torque	10% of full scale
Averaging Time (sec.)	5.0
External Trigger	Disabled
DATA Key Functions	
RS-232/USB Output	Enabled
Mitutoyo Output	Disabled
Memory Storage	Enabled
Backlight	Auto
Minutes	1
Serial/USB	
RS-232 Output Selected	Enabled
USB Output Selected	Disabled
Baud Rate	115,200
Data Format	Numeric + units
Auto Output	Disabled
Outputs per Sec.	125
Mitutoyo BCD Output	Disabled
Automatic Shutoff	Enabled
Minutes	5
Tones	
Keys	Enabled
Alerts	Enabled
Set Points	Momentary
Initial Settings	
Units	Depends on sensor
Mode	Real Time
Passwords	All passwords disabled

13.3 Dimensions IN [MM]



WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/ DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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- ☑ Flexible Heaters
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